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(54) Title: PRE-MIXED, READY TO INSTALL POLYMERIC COMPOSITIONS (57) Abstract <p>There is disclosed a method of producing a pre-mixed porous polymeric composition comprising the steps of: removing any water present from particles of material; mixing a moisture curing pre-polymer with the moisture free particles in a moisture free environments; depositing the mixture, in a moisture free environment, into containers which are impermeable to water vapour; storing the mixture containing containers for later use; and when required, and without further mixing, applying the composition to a suitable sub-base and allowing the composition to polymerise by reaction with water.</p>		

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Pre-Mixed, Ready To Install Polymeric Compositions

This invention concerns a method for the production of a pre-mixed porous polymeric compositions particularly, though by no means exclusively, suitable for the use in the formation of impact absorbing surfaces or substrates for sports or childrens' play areas.

Known such impact absorbing surfaces comprise particles of natural or synthetic rubber, such as SBR or EPDM for example, in a matrix of polymer, such as polyurethane for example. The particles typically comprise granules or shreds of rubber.

The matrix may completely fill the spaces between the particles to give a non-porous composition or simply coat the surfaces of the particles to cause them to adhere leaving interstices between the particles void to give a porous product.

Either kind of composition may be laid to form a sports or play surface or to form a substrate to another surface such as that provided by synthetic turf for example.

The compositions are prepared on site immediately before installation by accurately metering out the particles, liquid pre-polymer and, if necessary, a catalyst and thoroughly mixing them prior to laying in the manner of asphalt.

The on site preparation necessitates the use of mixing equipment and trained operators regardless of the size of the project. It would be desirable to eliminate the need for accurate on site metering of the constituent materials and thorough mixing thereof by pre-mixing the particles and pre-polymer and storing this mixture for later application. However, attempts to do so have previously been thwarted by unwanted polymerisation of the pre-polymer induced at mixing by the presence of moisture on the surface of the particles and after bagging by the diffusion of atmospheric moisture through the bag

walls. The amount of water absorbed by the rubber particles depends on ambient conditions and particle size. As an illustrative example, normal, commercially available SBR particles typically absorb ca. 0.5 to 1.0% water by weight. The mass of polyurethane pre-polymer that reacts with a unit mass of water is inversely proportional to the free NCO content of the pre-polymer. Typically the free NCO content is in the range 8 to 9%, with the result that any water present will react with ca. 40 times its mass of pre-polymer. This means that there is enough water present in commercially available SBR to polymerise all of the pre-polymer contained in a pre-mixed composition. This unwanted polymerisation will occur before the on-site application, either during pre-mixing or storage.

It is an object of the present invention to provide a method and materials for production of a pre-mixed porous composite which overcomes the disadvantages aforesaid.

According to the preferred aspect of the invention there is provided a method of producing a premixed porous polymeric composition comprising the steps of:-

removing any water present from particles of material;

mixing a moisture curing pre-polymer with the moisture free particles in a moisture free environment;

depositing the mixture, in a moisture free environment, into containers which are impermeable to water vapour;

storing the mixture containing containers for later use; and

when required, and without further mixing, applying the composition to a suitable sub-base and allowing the composition to polymerise by reaction with water.

The water may comprise atmospheric water or water applied as an atomised mist.

The particles may comprise natural or synthetic rubber and may be in the size range of from 1 mm to 10 mm.

The moisture free particles may be stored prior to mixing.

The drying of the particles, the mixing and deposition of the mixture may be carried out in a closed reactor.

The drying of the particles, the mixture and deposition of the mixture may be carried out in an open system maintained at a positive pressure by a stream of moisture free gas.

The removal of water from the rubber particles may be effected by evaporation at temperatures greater than room temperature. The evaporation may be carried out in a tunnel kiln.

The removal of water from the rubber particles may be effected by the application of a vacuum to the particles. The application of the vacuum may be performed in conjunction with the step of evaporating water from the particles at temperatures greater than room temperature.

Alternatively, the water may be removed from the particles by washing with moisture free solvent and the particles dried by a stream of moisture free gas.

In both of the above instances, the moisture free gas may be dry carbon dioxide, dry nitrogen or moisture free air.

The pre-polymer may be a polyurethane.

The pre-polymer may contain a catalyst in sufficient quantity so as not to cause polymerisation in the stored container but reduce the time required for polymerisation after application of the composition.

The mixing of pre-polymer with the moisture free rubber particles may be carried out with a ribbon mixer.

The water may be removed from the rubber particles by a chemical reaction.

A method of producing a pre-mixed porous polymeric composition in accordance with the present invention will now be described with reference to the accompanying drawing which shows a plant design for the production of pre-mixed polymeric compositions wherein water is removed from the rubber particles by evaporation.

Rubber granules 10 of between 1 and 10 mm diameter are fed onto the conveyor belt 12 of a tunnel kiln 14. A portion of the kiln is heated to a temperature well in excess of room temperature, and the granules are slowly passed through this portion in order to evaporate moisture from the surface of the granules. In a typical evaporation process the granules may be heated to temperatures in the range 100 - 150°C, usually around 120°C, for a period of ca. 10 minutes. The upper limit to the temperature which may be applied is given by the thermal stability of the rubber itself.

The granules, now moisture free, are emptied into a hopper 16. A stream of dry refrigerated carbon dioxide or nitrogen gas or moisture free air is expanded into the bottom of the hopper at positive pressure with respect to ambient gas pressure via gas input ports 18, 20. The gas stream has the effect of cooling the hot granules. The now heated exhaust gas from the hopper is ducted through the tunnel kiln at positive pressure; this process inhibits the intake of wet atmospheric air into the tunnel kiln.

From the hopper the granules are metered into the ribbon mixer 22 along with the appropriate amount of moisture curing pre-polymer such as polyurethane. A catalyst such as dibutyl tin mercaptide may be added with the pre-polymer in sufficient quantity so as not to cause polymerisation in the storage bag but reduce the time required for polymerisation after application of the composition. The positive pressure of the dry gas also prevents ingress of wet atmospheric air during the operation.

The mixture of dry granules and pre-polymer from the ribbon mixer is ducted to the bagging assembly 24, wherein water impermeable bags are filled with the granule/pre-polymer mixture. The water impermeable bags may comprise aluminium foil lined polythene sacks. The bags are opened, filled and sealed in the stream of dry gas, and once again the positive pressure of the gas stream inhibits seepage of wet atmospheric air into the dry confines of the bagging assembly and the bag itself.

After sealing, the bags of mixed polymeric composition may be stored before use. At ordinary temperature storage for up to a year is possible. This storage life time may be extended still further by storing at cooler temperatures. The polymeric composition may be installed to produce an impact absorbing surface by simply emptying the bags of pre-mixed polymeric composition and spreading the composition onto a suitable sub-base. The composition polymerises by reaction with ambient, atmospheric water vapour.

It is also possible to remove water from the granules by a vacuum treatment, i.e. by the application of a vacuum to the granules. Most advantageously, the vacuum treatment is applied **in conjunction** with the step of evaporating moisture by heating the granules to temperatures above room temperature. In this way, improved water removal is obtained and unwanted polymerisation during storage is minimised. It is possible that other reactive groups or species than water are present on the granules, and that the combined vacuum/heat treatment is removing, in addition to water, these as yet unidentified reactive groups or species from the surface of granules. Thus, it is understood that whilst the advantageous effects provided by the present invention primarily result from the removal of water from the granules, it is possible that the removal of other reactive species plays a role. The apparatus shown in the Figure may be modified so that a vacuum is applied during heating in the tunnel kiln 14. After the heating/vacuum treatment step, the further process steps described previously may be employed.

It will be appreciated that it is not intended to limit the invention to the above example only, many variations, such as might readily occur to one skilled in the art, being possible, without departing from the scope thereof.

One such variation involves the removal of moisture from the granules by washing same with a dry solvent.

Another variation involves coating the granules with an agent such as an isocyanate derivative. The agent removes water from the surface of the granules by chemical reaction and, additionally, the agent reacts with a chemical, added after the water removal, such as a polyol, to produce the pre-polymer in situ.

Although the preferred aspect of the invention entails storing the granules without any water present and effecting curing through air-borne water, the invention

comprehends the possibility of storing the granules without some other air-borne curing agent such as oxygen and allowing such agent to effect curing after laying.

CLAIMS

1. A method of producing a pre-mixed porous polymeric composition comprising the steps of:-

removing any water present from particles of material;

mixing a moisture curing pre-polymer with the moisture free particles in a moisture free environment;

depositing the mixture, in a moisture free environment, into containers which are impermeable to water vapour;

storing the mixture containing containers for later use; and when required, and without further mixing, applying the composition to a suitable sub-base and allowing the composition to polymerise by reaction with water.

2. A method according to claim 1 in which the water comprises atmospheric water.

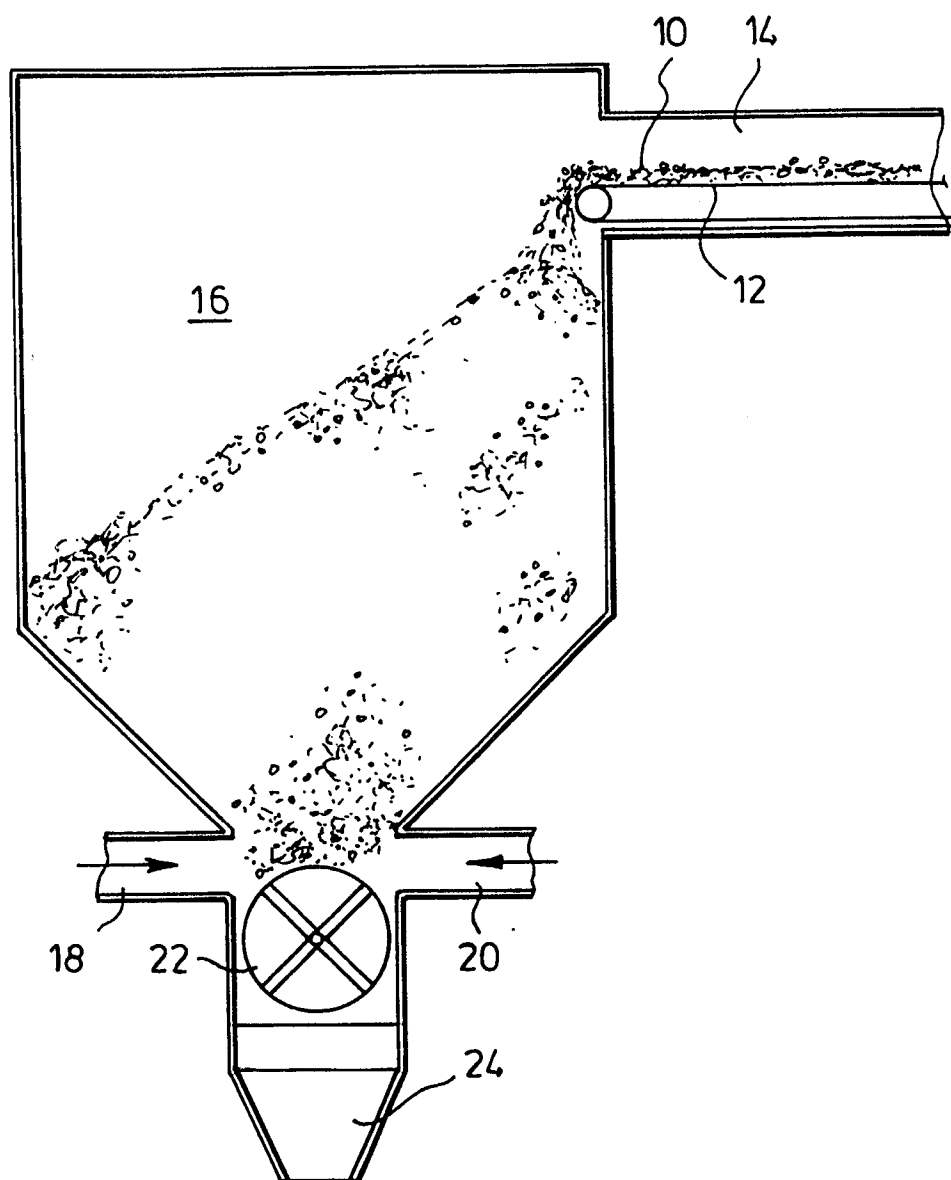
3. A method according to claim 1 or claim 2 in which the water is applied as an atomised mist.

4. A method according to any of claims 1 to 3 in which the particles comprise natural or synthetic rubber.

5. A method according to claim 4 in which the particles are in the size range of 1 mm to 10 mm.

6. A method according to any of the previous claims in which the moisture free particles are stored prior to mixing.
7. A method according to any of the previous claims in which the drying of the particles, the mixing and deposition of the mixture are carried out in a closed reactor.
8. A method according to any of the previous claims 1 to 6 in which the drying of the particles, the mixing and deposition of the mixture are carried out in an open system maintained at a positive pressure by a stream of moisture free gas.
9. A method according to any of the previous claims in which the removal of water from the particles is effected by evaporation at temperatures greater than room temperature.
10. A method according to claim 9 in which the evaporation is carried out in a tunnel kiln.
11. A method according to any of the previous claims in which the removal of water from the particles is effected by the application of a vacuum to the particles.
12. A method according to claim 11 in which the application of the vacuum is performed in conjunction with the step of evaporating water from the particles at temperatures greater than the room temperature.
13. A method according to any of claims 1 to 6 in which water is removed from the particles by washing with moisture free solvent and the particles are dried by a stream of moisture free gas.

14. A method according to claim 8 or claim 13 in which the moisture free gas is dry carbon dioxide, dry nitrogen or moisture free air.
15. A method according to any of the previous claims in which the pre-polymer is a polyurethane.
16. A method according to any of the previous claims in which the pre-polymer contains a catalyst in sufficient quantity so as not to cause polymerisation in the stored container but reduce the time required for polymerisation after application of the composition.
17. A method according to any of the previous claims in which the mixing of pre-polymer with the moisture free particles is carried out with a ribbon mixer.
18. A method according to any of the previous claims in which the water is removed from the particles by a chemical reaction.



INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 98/00276

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 C08G18/10 C09J175/04 E01C13/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 C08G C09J C08L C08J E01C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 96 09338 A (BOWERS) 28 March 1996 see the whole document ---	1-18
A	DE 37 21 688 A (PHILIPP/HOF) 12 January 1989 see column 2, line 68 - column 3, line 68; claims 1-4 ---	1
A	EP 0 565 754 A (BLUM) 20 October 1993 see page 2, line 31 - page 4, line 6; claim 1 ---	1, 15, 16
A	EP 0 005 473 A (BAYER) 28 November 1979 see page 3, line 22 - page 10, line 5; claims 1-3 --- -/--	1

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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